# How Mobile IoT is Changing the Industrial Landscape

2018

The GSMA represents the interests of mobile operators worldwide, uniting more than 750 operators with over 350 companies in the broader mobile ecosystem, including handset and device makers, software companies, equipment providers and internet companies, as well as organisations in adjacent industry sectors. The GSMA also produces industry-leading events such as Mobile World Congress, Mobile World Congress Shanghai, Mobile World Congress Americas and the Mobile 360 Series of conferences.

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## About the GSMA Internet of Things Programme

The GSMA's Internet of Things Programme is an industry initiative focused on:

- ⬊ COVERAGE of machine friendly, cost effective networks to deliver global and universal benefits
- ⬊ CAPABILITIES to capture higher value services beyond connectivity, at scale
- ⬊ CYBERSECURITY to enable a trusted IoT where security is embedded from the beginning, at every stage of the IoT value chain

By developing key enablers, facilitating industry collaboration and supporting network optimisation, the Internet of Things Programme is enabling consumers and businesses to harness a host of rich new services, connected by intelligent and secure mobile networks.

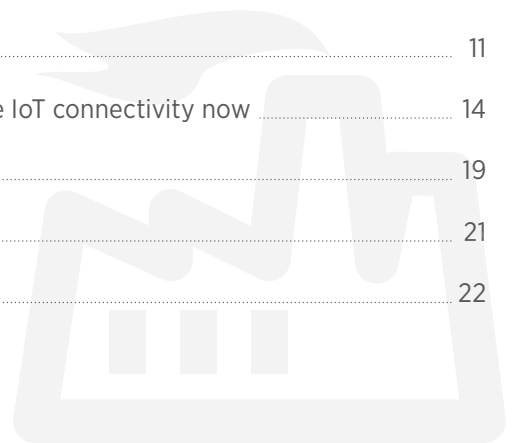Visit gsma.com/iot or follow gsma.at/iot to find out more.

## About the Mobile IoT Innovators

The GSMA Mobile IoT Innovators is the official industry community for LPWA technologies in licensed spectrum. Uniting over 1,000 companies and bringing operators, vendors, manufacturers, developers, consultants and end customers together, the Mobile IoT Innovators provide a vibrant ecosystem around Mobile IoT.

To find out more and join for free to receive exclusive benefits, please visit gsma.com/mioti

# Contents

# Executive Summary

Cellular technologies are evolving to meet the growing demand in industry for more production data, predicative maintenance and greater automation. Using licenced spectrum to provide low power wide area (LPWA) connectivity - Mobile Internet of Things (Mobile IoT) technologies are playing a pivotal role in connecting factories, machines, industrial equipment and sensors, to enable a more advanced, efficient and flexible way of working. LTE-M and NB-IoT, the two Mobile IoT technologies, are ideally suited to providing cost-effective, secure and reliable connectivity to legacy machinery with a long lifespan. Both technologies can penetrate deep within factory buildings, allowing connectivity to reach machines below ground level and other inaccessible places.

For example, the Wanxiang group in China is using China Unicom's NB-IoT network to monitor the manufacturing of automotive parts to ensure quality traceability. The data collected means that the parts have a traceable history of information from time of manufacture. Sensors collect multiple inputs including, processing status, temperature and humidity attached to the part's serial numbers. NB-IoT is also used to monitor the machines' performance, enabling predictive maintenance and a reduction in failures.

Atlas Copco of Sweden is working worldwide with Sierra Wireless to employ Mobile IoT networks to connect metallic industrial air compressors in basements, which are beyond the reach of other wireless technologies. This enables usage statistics to be sent back to enterprise systems, allowing Atlas Copco to provide pay per use rental and predictive maintenance.

Mobile IoT networks can connect a high density of devices securely and reliably over larger coverage areas than traditional wireless connectivity. In some cases, Mobile IoT-enabled industrial gateways are being used to connect legacy equipment to cloud services, making data collection and analysis more reliable and efficient.

Wirelessly connecting machines and sensors offers great advantages in terms of flexibility and deployment costs. Huawei and Hothink estimate the deployment cost of an in-door smart smoke and gas detector, for example, can be lowered by as much as 90% through the use of wireless, rather than wired, connections. As they are based on global standards, cellular technologies can also connect production plants to their supply chains, enabling the optimisation of logistics and distribution.
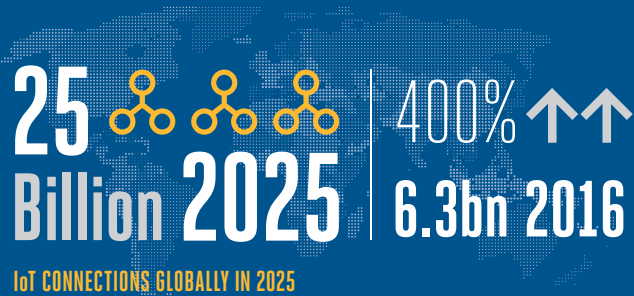
With the addition of new 5G technologies in the next few years, cellular networks will also be able to support critical and low latency wireless communication within factories and industrial sites. As Mobile IoT is an inherent part of 5G, the LTE-M and NB-IoT networks being deployed today will continue to play an important role in the 5G future.
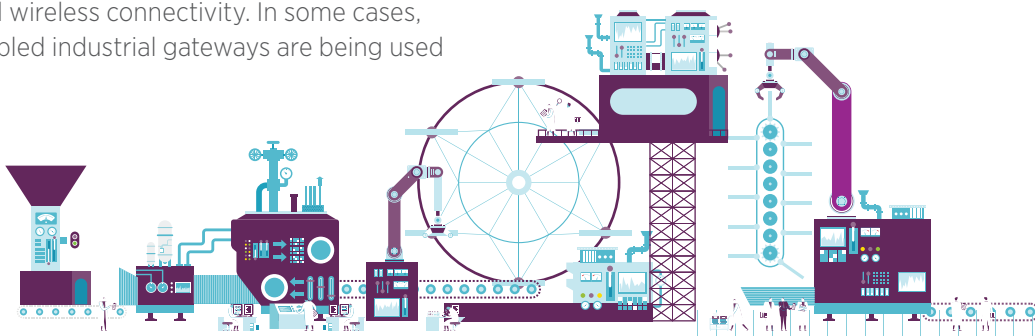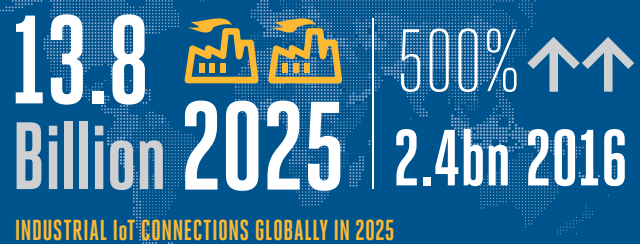
# Introduction

Industry is embracing the Internet of Things (IoT). Large numbers of connected sensors are now being used to monitor the performance of complex physical machinery in real-time. Analysis of the resulting data can be used to optimise production and perform predictive maintenance, increasing efficiency and generating insights that can be used to develop new processes. As industry players start to realise the benefits of connecting equipment within their production line and to their supply chains, demand for Industrial IoT solutions has soared.

To help industry navigate the maze of wireless connectivity options on offer, this document highlights the suitability of Mobile IoT technologies for use in the Industrial IoT space. As they operate in licensed spectrum and are provided by mobile operators, both LTE-M and NB-IoT provide secure and reliable low power wide area (LPWA) connectivity. The paper includes case studies of how Mobile IoT technologies are being used by industry today, highlighting the benefits of leveraging this versatile and low cost connectivity for industrial applications.

**13.8 Billion 2025** | **500% ↑↑** **2.4bn 2016**

INDUSTRIAL IoT CONNECTIONS GLOBALLY IN 2025

*Source: GSMA Intelligence 2018*

Industrial IoT connections will overtake consumer IoT connections in 2023 and will increase more than five-fold between 2016 and 2025, from 2.4 billion to 13.8 billion, according to GSMA Intelligence. The industrial segment will account for just over half of all IoT connections in 2025 as IoT solutions are deployed within enterprises and vertical-specific applications, such as manufacturing and energy management.

GSMA Intelligence anticipates that IoT connections for smart manufacturing alone will grow at a rate of over 30% annually between 2018 and 2023 (see Figure 1) as companies recognise the importance and value of connecting multiple assets and machines within factories and warehouses, to increase efficiency and reduce downtime.[1]

**25 Billion 2025** | **400% ↑↑** **6.3bn 2016**

IoT CONNECTIONS GLOBALLY IN 2025

*Source: GSMA Intelligence 2018*

GSMA Intelligence forecasts that IoT connections will reach 25 billion globally in 2025, up from 6.3 billion in 2016 – almost a fourfold increase.

[1] https://www.gsmaintelligence.com/

The business case for the IoT is increasingly focused on addressing specific problems or needs, aided by the emergence of horizontal platforms that collect, process and integrate data from multiple data sources. These data sources are becoming increasingly important to improve efficiency and to decrease the amount of that machines are idle.

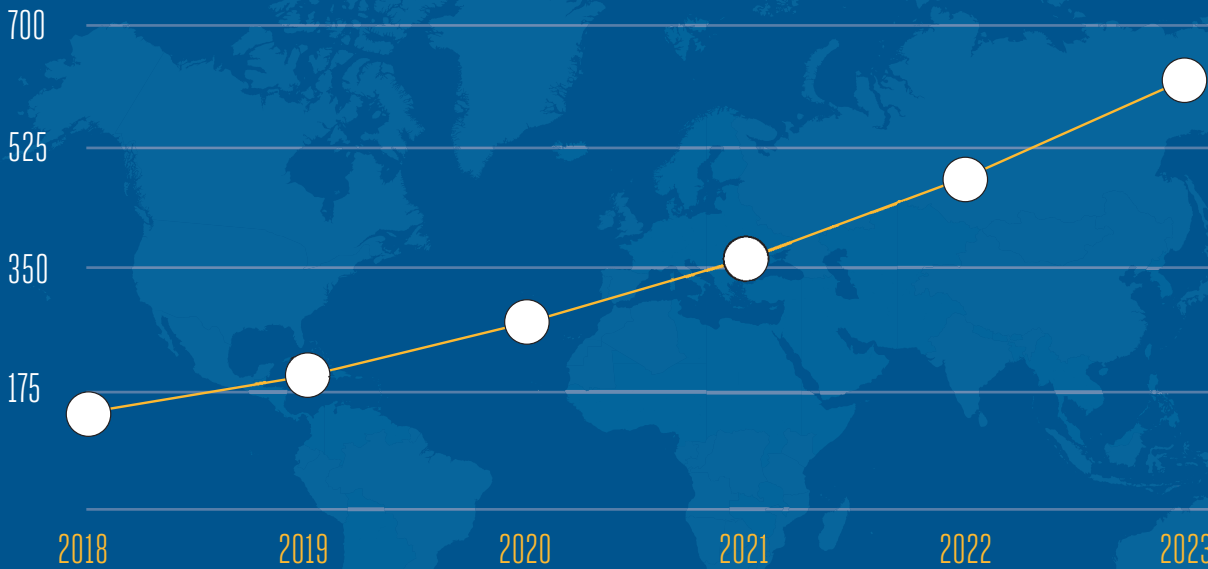**Smart Manufacturing Connections (millions)**



**Figure 1:** Smart Manufacturing Connections by year

*Source:* GSMA Intelligence

Supplemented by 5G enhanced broadband and 5G critical communications services, Mobile IoT networks will be able to meet the full set of industrial use cases, enabling the Industrial IoT to move entirely to a wireless communications paradigm.

# What is Mobile IoT?

Conventional cellular technologies, from GSM to LTE, have been designed to be used by people. These systems have been optimised around the way humans communicate and use telecoms services. However, over time, these systems are being used more and more for machine-centric communications, such as those that comprise the IoT. With this expanding usage profile comes a distinct set of requirements which the mobile industry has addressed with a set of secure low-cost connectivity technologies designed specifically to support the IoT. These technologies are known as Mobile IoT.

Mobile IoT is a GSMA term that refers specifically to the 3GPP-standardised low power wide area (LPWA) technologies, such as LTE-M and NB-IoT, which use licensed spectrum bands managed by mobile operators.

Mobile IoT technologies possess the following characteristics:

- ⭲ Low power consumption that enables devices to operate for many years on a single charge
- ⭲ Low device unit cost
- ⭲ Improved outdoor and indoor coverage compared with existing cellular and some unlicensed LPWA technologies
- ⭲ Secure two-way connectivity and strong authentication
- ⭲ Optimised data transfer for small, intermittent blocks of data
- ⭲ Simplified network topology and deployment
- ⭲ Network scalability for capacity upgrades

LTE-M is the industry term for the LTE machine-type communications (MTC) LPWA technology standard introduced by 3GPP in Release 13. LTE-M supports massive connection density, low device power consumption, voice telephony and provides extended coverage, while allowing the reuse of LTE base stations. The deployment of LTE-M can be achieved "in-band" within a normal LTE carrier, or "standalone" in dedicated spectrum.

Narrowband IoT (NB-IoT) is a 3GPP radio technology standard introduced in Release 13 that addresses the LPWA requirements of the IoT. NB-IoT is characterised by improved indoor coverage, support for a massive number of low throughput devices, delay tolerance, low device power consumption and optimised network architecture. Like LTE-M, NB-IoT can be deployed "in-band" within a normal LTE carrier, or "standalone" for deployments in dedicated spectrum. Additionally, NB-IoT can also be deployed in an LTE carrier's guard-band.

Since the first 3GPP release of LTE-M and NB-IoT specifications in 2016, the growth in the number of Mobile IoT connections and networks across the world has accelerated. By August 2018, 66 commercial LTE-M and NB-IoT networks had been launched across 33 markets.[2]

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[2] Refer to https://www.gsma.com/iot/mobile-iot-commercial-launches/ for the most up-to-date information

" " *Mobile IoT is a GSMA term that refers specifically to the 3GPP-standardised low power wide area (LPWA) technologies, such as LTE-M and NB-IoT, which use licensed spectrum bands managed by mobile operators.* " "

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# What is Industrial IoT?

Also known as "Smart Manufacturing", "Factories of the Future", the "Fourth Industrial Revolution" or "Industry 4.0", the Industrial IoT enables various machines and equipment in an industrial setting to be interconnected and monitored, leading to improvements to the efficiency of industrial production and logistics. Ubiquitous secure wireless connectivity, coupled with powerful cloud computing systems, can increase the flexibility and robustness of the industrial production system.

There are a broad range of potential applications of the Industrial IoT, including intelligent production processes, cloud manufacturing platforms, collaborative manufacturing and collaborative innovation platforms, industry e-commerce and intelligent product development tools. For example, industrial enterprises can build cloud platforms to enable greater interconnectivity both within the enterprises themselves, and also along the entire industrial value chain.

## Industrial application categories

As the Industrial IoT covers a broad set of use cases, often with different requirements, a set of typical application categories are provided below to help illustrate further the intricacies of the Industrial IoT.[3]

**1. Logistics and warehousing:** the flow and storage of materials and goods for industrial production. One example use case is to track the location and transport conditions (e.g. temperature) of sensitive raw materials bound for the factory to ensure the raw material quality, to improve logistical operations and to anticipate deliveries.

**2. Monitoring and maintenance:** passive monitoring of specific processes and/or assets for maintenance and predictive maintenance purposes. One example use case is to predict when machines on the factory floor are likely to fail, so that downtime can be scheduled to minimise disruption to the factory operations.

**3. Production IT:** IT systems that monitor the factory and process automation, as well as the business processes. One use case employs manufacturing execution systems to monitor and document how raw materials and/or basic components are transformed into finished goods.

**4. Factory automation:** the automated control, monitoring and optimisation of processes and workflows within a factory. One use case is motion control in packaging machines, which employ moving and rotating parts to package the product. This application category typically has very strict low latency requirements.

**5. Process automation:** the control of production and handling of products. One use case is for a closed loop control process where sensors take continuous measurements that can trigger specific action by actuators. Such applications generally have a very strict low latency requirement.

**6. Human-machine interfaces:** interaction between people and production facilities, such as panels attached to a machine, and standard IT equipment, such as PCs and smartphones. For example, augmented reality or virtual reality can be used to assist in step-by-step instructions for specific tasks in a manual assembly workplace. This application category can have a very strict low latency requirement.

Whilst a number of industrial application categories require very high-performance requirements (e.g. low latency and fast response times), there are a number of categories that can be supported by Mobile IoT today, as there are no strict latency requirements. Moreover, within each application category there are a variety of use cases with differing performance requirements, which also means that several use cases within each category may already also be implemented using Mobile IoT (see Figure 2).

**DELAY TOLERANT**

**PRODUCTION IT**

**LOGISTICS AND WAREHOUSING**

**MONITORING AND MAINTENANCE**

**FACTORY AUTOMATION**

**HUMAN-MACHINE INTERFACES**

**PROCESS AUTOMATION**

**DELAY SENSITIVE**

**Figure 2:** Delay sensitivity for different Industrial applications

## Key industrial requirements

A number of requirements for communication systems that are specific to the industrial landscape are highlighted below:[4]

**1.** Production facilities usually have a rather long life-time, which may be 20 years or even longer. Therefore, long-term availability of communication services and components are essential.

**2.** Some use cases are supported by deploying an isolated private network or a private network with seamless interoperability with a public network within a factory or plant. This is required for security, liability, availability and business reasons.

**3.** Seamless integration into the existing (primarily wire-bound) connectivity infrastructure is required. For example, the ability to flexibly combine the existing wire-bound technologies with other technologies in the same machine or production line.

**4.** There is not only a single class of use cases, but there are many different use cases with a wide variety of different requirements, resulting in the need for high adaptability and scalability of the communication system.

**5.** Many applications have stringent requirements on safety, security (especially availability, data integrity, and confidentiality), and privacy.

**6.** Industrial-grade quality of service is required for many applications, with stringent requirements in terms of end-to-end latency, communication service availability, jitter, and deterministic transmission time/latency.

**7.** The radio propagation environment in a factory or plant can be quite challenging. It is typically characterised by very rich multipath, caused by a large number of, often metallic, objects in the immediate surroundings of transmitter and receiver, as well as potentially high interference caused by certain industrial machines.

**8.** Support of continuous monitoring of the network state in real-time, to take quick and automated actions in case of problems and to do efficient root-cause analyses in order to avoid any undesired interruption of the production processes, which may incur major financial damage.

The cellular ecosystem is working to introduce support for all of these requirements in 5G. However, some industry-specific requirements, such as private operations and long technology lifetime, can already be achieved today with Mobile IoT technologies.

There are industrial applications that require a very high degree of reliability such that a business case could be made for a privately-deployed network that is operated and managed by the industrial player. Conversely, there are also other industrial applications where such strict needs are not necessary in order to have a success-ful solution. In these cases, industrial players can take advantage of the publicly deployed Mobile IoT networks to provide connectivity for their industrial solutions.

# Benefits of Mobile IoT in the industrial space

In industry, wireline communications technologies are typically used in critical systems, such as an automated assembly line, to interconnect sensors, actuators and controllers. Up until recently, wireless technologies in the industrial context have been used mainly for non-critical systems, as previous generations of wireless technologies did not meet the requirements for industrial systems.

However, there are a number of challenges associated with wireline technologies that can now be solved relatively easily using wireless Mobile IoT technologies (see Figure 3):

#### ◤ SCALABILITY:

Wired networks are limited in terms of scalability, as connecting each new asset in a new location could incur substantial costs due to additional wiring that needs to be planned and installed. Furthermore, it is difficult to support a very dense deployment of connected equipment and sensors. Ericsson estimates that there can be up to one connected device every two square meters in a typical smart factory[5]. Wireless networks, in particular Mobile IoT technologies, are designed for and well suited for dense endpoint deployments.

#### ◤ AFFORDABILITY:

The cables and equipment used for wired connections can get damaged, requiring repairs or replacement, incurring additional costs. Ericsson estimates it costs up to €200 (US$230) per metre to install and maintain cabling.[6] Conversely, the use of Mobile IoT networks eliminates the costs associated with maintaining wiring and cabling equipment, in addition devices require zero configuration.

#### ◤ FLEXIBILITY:

Existing wired systems are difficult to re-deploy or move. Wired networks need to be planned in advance in terms of the location of the wiring and equipment, so installation can take time. This also means that wired networks, once installed, cannot be expanded or relocated easily and quickly. Mobile IoT networks, on the other hand, allow sensors and connected assets to be re-deployed easily and effectively. They can support regular changes to the production line setup, for example. A Mobile IoT solution can also be retrofitted on to older machines and assets, as depending on the application, a battery-operated module can be installed without the need for mains power connection.

#### ◤ MOBILITY:

Wired connections are bound to specific locations. Depending on the location of the assets to be connected, the wired connection must be able to reach the asset. This limits the placement of the asset within the facility, and also limits the wired installation to assets that are in a fixed location. With Mobile IoT-based solutions, assets can be connected regardless of whether they remain stationary or not, and also allow connectivity both inside and outside the production facility, allowing industrial players to connect with their wider supply chain.

[5] http://www.ericsson.com/mobility-report
[6] Ericsson.com – 'A guide to smart wireless manufacturing'

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**SCALABILITY**

↘ Dense endpoint

**AFFORDABILITY**

↘ Use of public network

**FLEXIBILITY**

↘ Adaptable configuration

**MOBILITY**

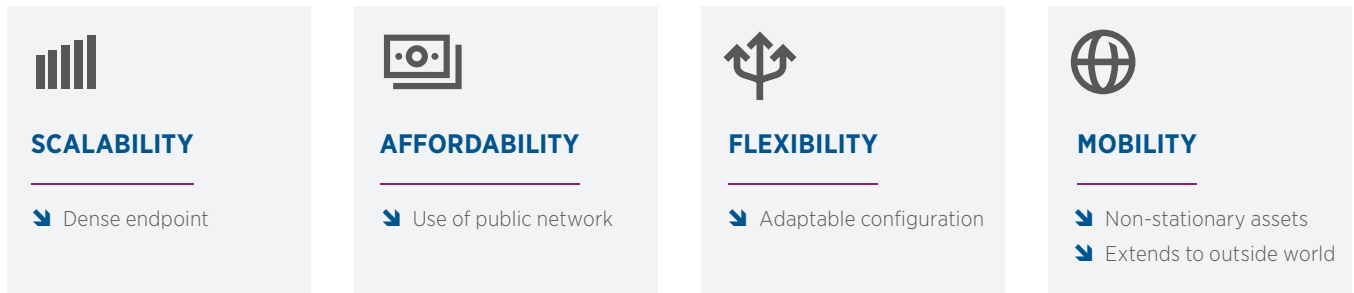↘ Non-stationary assets
↘ Extends to outside world

**Figure 3:** Key Benefits of Mobile IoT technologies

Cellular technologies are also well-suited to meeting the security and privacy requirements of industrial players, as they benefit from security layers that harness years of experience in dealing with various security challenges and learnings from previous generations of cellular systems.

Mobile IoT connectivity shares cellular network architectures and provides similar transport layer security mechanisms and constraints. As a result, several security mechanisms are available such as:

↘ Device/network mutual authentication
↘ Securing of communication channels
↘ Ability to support "end-to-end security" at the application level
↘ Secure provisioning and storage of device identity and credentials

In cellular systems, data privacy can be preserved via different mechanisms including the use of encrypted links between the operator network and the customers' network.

More information is available within the GSMA IoT Security guidelines[7].

Mobile IoT, as with all cellular technologies, uses licensed spectrum, reducing interference, enabling efficient traffic management. As the spectrum is used exclusively, and typically managed by a single operator, there is less interference, better reliability and quality of service. The use of licensed spectrum also ensures that the service can utilise the mobile operator's global services and achieve a larger scale.[8]

Industrial IoT players can overcome the challenges discussed in this section by taking advantage of the advances in cellular technology encapsulated in Mobile IoT networks. Mobile IoT supports industrial applications that require intermittent small data transfers, low power consumption and / or improved coverage or penetration. For industrial use cases that need very low latency and strict response times in a given geographical area and spectrum allocation, 5G will fulfil these 'critical IoT' requirements.

[7] https://www.gsma.com/iot/future-iot-networks/iot-security-guidelines/
[8] https://www.gsma.com/iot/wp-content/uploads/2016/10/3GPP-Low-Power-Wide-Area-Technologies-GSMA-White-Paper.pdf

# Mobile IoT from the 5G perspective

Both to enhance the human user experience and enable various machine-related use cases, 5G will allow multiple access technologies, such as satellite, WiFi™, fixed line and 3GPP technologies, to interwork to serve diverse use cases. This approach means that existing 3GPP technologies, LTE-M and NB-IoT, are now part of the 5G family.[9]

While 5G will deliver higher data rates and lower latency, these capabilities are mainly focused on the mobile broadband and real-time control use cases. Conversely, for many machine-related use cases, the requirements are at the other end of the spectrum where low bit rates and latency tolerance are the norm.

To serve a wide variety of use cases, often with opposing requirements, 5G systems dynamically allocate the network resources depending on the use case. The 5G standard has been designed to support three main sets of requirements:

⬎ **Massive IoT / LPWA:** improved network coverage, long device operational lifetime and a high density of connections that support a number of Industrial IoT applications. This is also known as mMTC (massive machine type communications).

⬎ **Enhanced mobile broadband:** improved performance and a more seamless user experience accessing multimedia content for human-centric communications, with performance that can support a number of delay-sensitive Industrial IoT applications.

⬎ **Critical communications:** high performance, ultra-reliable, low latency and mission critical applications, to be developed to support the most delay-sensitive Industrial IoT applications. This is also known as Critical IoT, URLLC (ultra-reliable low latency communications).

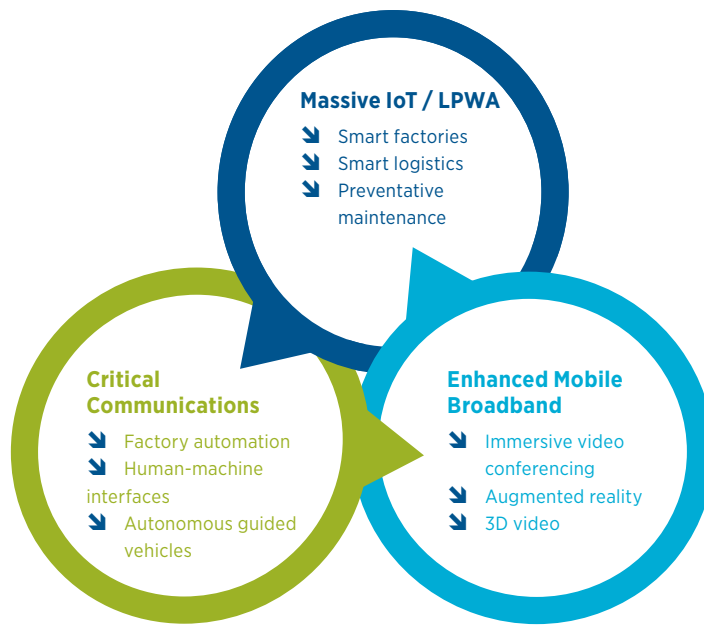Figure 4 shows the main categories of 5G use cases with a few examples.

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[9] https://www.gsma.com/iot/mobile-iot-5g-future/

**Figure 4:** Example 5G Use Cases

Figure 5 presents a range of application categories for Massive IoT LPWA. LTE-M and NB-IoT have already been designed to address the requirements of these use cases, including support for a large numbers of devices, low device cost, ultra-long battery life, and coverage in challenging locations. These requirements will still apply for Massive IoT in the 5G context.[10] In addition, Mobile IoT networks can support a high connection density in terms of number of connections in a given geographical area and spectrum allocation.
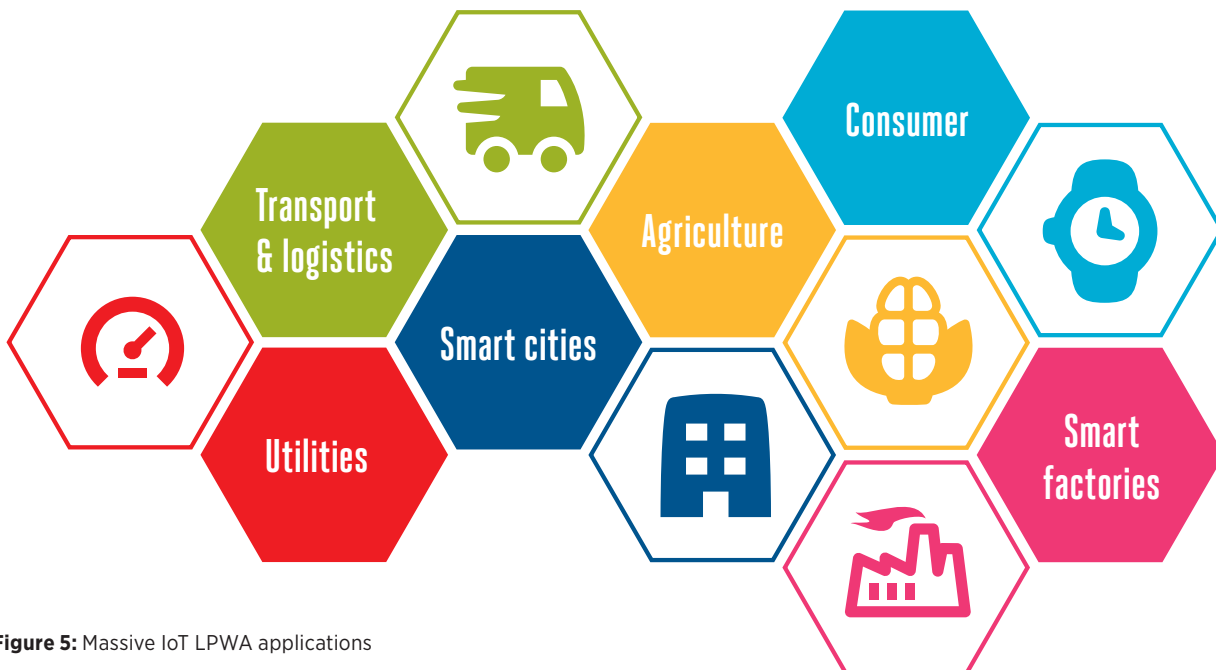


**Figure 5:** Massive IoT LPWA applications

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[10] https://www.gsma.com/iot/mobile-iot-5g-future/

Industrial IoT use cases and categories that can tolerate some delay can be implemented with Mobile IoT today, while 5G's critical communications capability will support delay-sensitive use cases and categories. Figure 6 shows the various 5G network components that will be built up and deployed over time. It highlights that the Mobile IoT network components already operational today will eventually coexist with other 5G components, such as enhanced mobile broadband and critical communications, deployed in the same networks at a later point in time.

This deployment and evolution model fits in well with the industrial requirement for long production facility lifetimes, as it allows Mobile IoT technologies to operate seamlessly in 5G spectrum bands, and thus helps to meet the requirement of a 20-year operational lifetime.

Leading mobile operators, including AT&T, Deutsche Telekom, KDDI, Orange and Vodafone, are committed to deploying these networks as part of their 5G Massive IoT strategies[11].

Cellular Network

5G Critical Communications

5G Enhanced Mobile Broadband

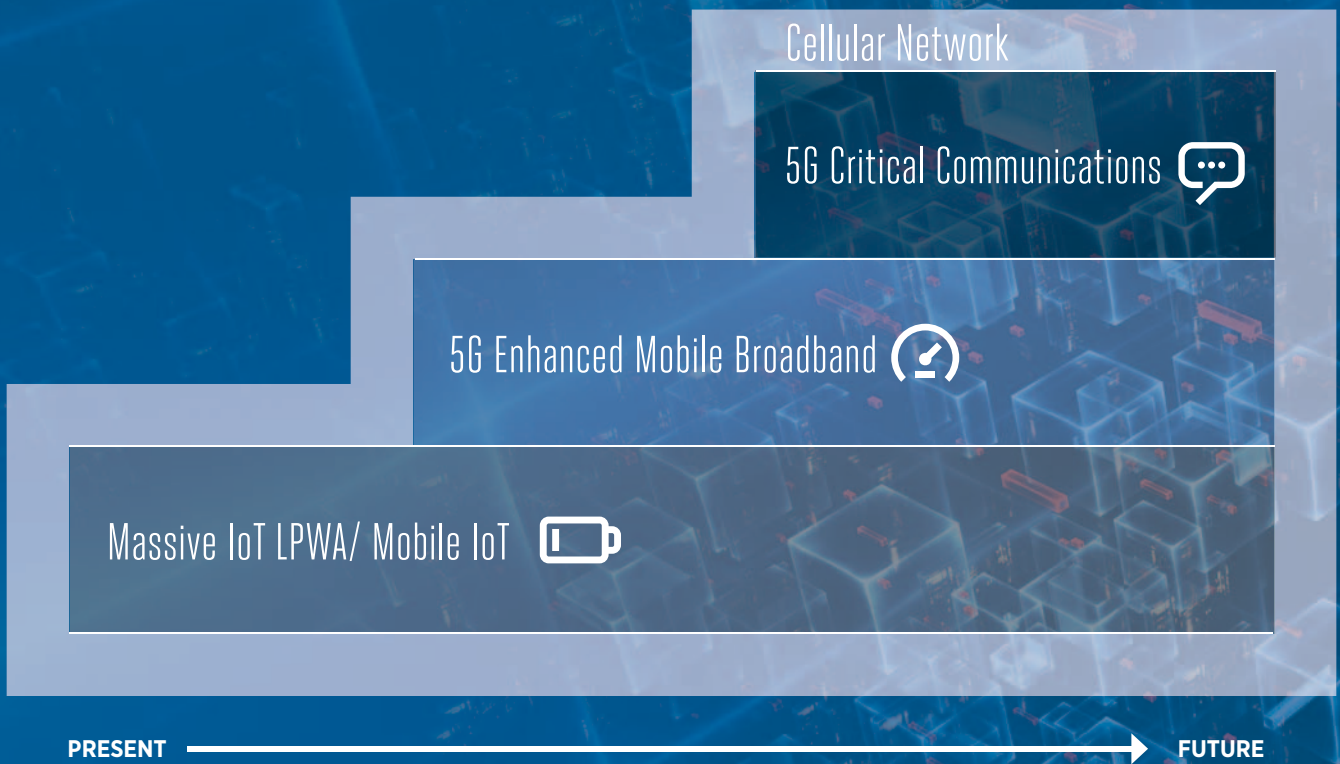Massive IoT LPWA/ Mobile IoT

PRESENT → FUTURE

**Figure 6:** 5G network components that will be built up and deployed over time

[11] https://www.gsma.com/newsroom/press-release/new-gsma-report-highlights-integral-role-of-mobile-iot-networks-in-5g-future/

# USE CASES - HOW THE INDUSTRIAL SECTOR IS BECOMING SMARTER THROUGH MOBILE IOT CONNECTIVITY NOW

## China Unicom, Kysun and Wanxiang Group intelligent workflow production monitoring and analysis of automotive parts

Wanxiang group, an automotive components maker, Kysun and China Unicom are using LTE-M and NB-IoT connectivity to monitor the whole production process of automotive parts to ensure efficient production, achieve traceable quality control and to enable predictive maintenance. Wanxiang's industrial machines are connected to a gateway via industrial Ethernet or fieldbus, which uses China Unicom's Mobile IoT network to connect wirelessly to Kysun's cloud platforms.

Traceable quality is achieved by monitoring and collecting data during production using rigidity and pressure sensors, which is sent to the cloud system for processing. The system also collects other data,

including the serial number of the products, processing status, cooling status, lubrication status, the speed and power of the main shaft, warning messages, production efficiency, real time power consumption, voltage, electric current, temperature and humidity information. The likelihood of machine failure can be calculated through data analysis performed in the cloud allowing for predictive maintenance. Mobile IoT technology meets the requirement for highly reliable connectivity to the machines, prevents data congestion within the factory and requires little maintenance, making it the preferred choice over Wi-Fi™, which was previously used.

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# Ericsson employing Mobile IoT connectivity to improve processes in a real manufacturing environment[12]

Ericsson has connected multiple systems and sensors in its factories using Mobile IoT technology. For example, the telecoms equipment maker employs a wireless Andon system to enable operators on its production lines to call for technical support when a quality problem occurs. This Mobile IoT solution has replaced an inflexible wireline system in which the shift leader got the call on his or her screen and then had to manually find the right engineer to address the problem. The new LTE-M solution uses voice over LTE (VoLTE) to make a call directly to the right engineer from the line, reducing the lead-time for problem solving.



**Figure 8:** High-precision screwdriver

maintenance, in turn extending the life time of the screwdrivers. The solution has reduced maintenance material costs by US$1,000 each year and manual maintenance work costs have been cut in half, saving US$10,000 annually.



**Figure 7:** Andon call system

Moreover, the Ericsson Panda manufacturing plant in Nanjing, China, uses NB-IoT to capture data from high-precision screwdrivers via attached motion sensors. The sensors are used to measure the usage of the devices so that they can be torque calibrated efficiently at the correct time interval. Previously the screwdrivers were calibrated at fixed time intervals and the information was recorded in hand written logs. With the NB-IoT enabled sensor, data is captured every eight hours allowing the private cloud system to analyse the performance of the tools, enabling predictive



**Figure 9:** Factory Environmental Monitor

Ericsson also uses Mobile IoT technologies for many other use cases in its factories, including to send pressure sensor data for monitoring how full boxes are, environmental monitoring data, workstation output data and for tracking assets resulting in further efficiency and cost savings. As Mobile IoT allows for a dense number of connections, it is well suited for use in an industrial factory setting with many sensors collecting data from many different machines and production lines.

[12] https://www.gsma.com/iot/ericsson-smart-industrial-factory

## Horus predictive maintenance, early warning system for plant equipment failure[13]

Horus and building contractor BAM have developed Sentinel, which uses low power NB-IoT technology in an early warning system for monitoring the health of plant equipment, including HVACs, chillers, boilers and pumps. The device is physically attached to the equipment to be monitored (see Figure 10) and calculates the condition of it using a combination of thermal, vibration and acoustics. It can be easily retrofitted to existing machines. Its algorithms learn the characteristics of the equipment being monitored and use NB-IoT to send alerts of any deviations from the learned behaviour.

The low power usage of NB-IoT enables the device to be battery powered, while its extended coverage allows for deep penetration in the types of environment that the Sentinel will be deployed in. "The use of wireless connectivity means deployment can be low cost, at less than €100 (US$115) for each device, making it feasible to monitor large numbers of assets, in turn increasing the overall saving potential" says Patrick Robinson, VP Sales and Marketing Horus IoT. The mitigation of major



**Figure 10:** A connected monitor from Horus attached to factory equipment

equipment damage, combined with the optimisation of regular equipment assessment procedures, can save many man hours of effort. Equipment monitoring is also more precise than with traditional methods, as the device measurements are not affected in the same way as manually taken readings. Overall the solution can increase efficiency in a number of areas - maintenance robustness, reduction in downtime, scheduling of necessary maintenance, repair, instead of replacing, and for identifying the best value option for future purchases.

> " The use of wireless connectivity means deployment can be low cost, at less than €100 (US$115) for each device, making it feasible to monitor large numbers of assets, in turn increasing the overall saving potential "

**Patrick Robinson,** VP Sales and Marketing Horus IoT.

[13] http://www.horus.ie/

# Huawei and partners Hothink and Tanda smart fire and toxic gas detection[14]

Many industrial locations need fire and gas detection systems, but they are not always easy to install, requiring a mains connection or frequent battery changes, cabling and high maintenance costs. Huawei and its partners, such as Hothink, Heiman and Tanda, have developed NB-IoT-connected detectors, which are low power, do not require cabling and can be deployed easily. Huawei estimates deployment costs can be 90% lower than in the case of a wired detector.

The Hothink detector (see Figure 11) is connected via a mobile operators' NB-IoT network to a cloud system, which is linked directly into the fire service centre, which can be alerted to an alarm in near real time. The detectors also send regular heartbeat messages to ensure the system knows the detector is active, reducing risk of faults, loss of service and maintenance costs.

Connected by NB-IoT, a wireless detector can run for 3-5 years using a 3000mAh battery. NB-IoT's extended coverage over traditional GSM means the detectors can also be deployed in areas that were not previously accessible using cable or traditional wireless technologies.



**Figure 11:** A Hothink detector connected via NB-IoT

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[14] https://www.huawei.com/minisite/iot/en/smart-smoke-detector.html

## Sierra Wireless is transforming Atlas Copco's industrial compressor business[15]

Atlas Copco has integrated the Sierra Wireless FX30 IoT Gateway, which uses LTE-M, into its industrial air compressors, expanding their customer service capabilities. The small, flexible and rugged gateway is connected to the compressors' existing CAN connections allowing machine data and usage statistics to be sent securely and reliably back to enterprise systems over mobile operators' networks. The compressors can then be rented based on usage statistics.

Machine data also enables Atlas Copco to provide preventive maintenance, which gives local service teams the ability to deliver the right spare part at the right time for faster fault resolution, saving costs associated with breakdowns and production loss. Moreover, customers can use the data to manage energy usage efficiently and further increase product reliability. In addition, GNSS-positioning capabilities can be used to track the device, if it is removed from the intended site.

The biggest advantage of using LTE-M in this case is the coverage gain over traditional GSM technology. As the compressors are dense metallic environments and are often located at basement level, they can only be connected by technologies that can penetrate walls and below ground. The use of Mobile IoT also enables the solution to be deployed worldwide as the FX30 IoT Gateway supports multiple frequency bands.



**Picture:** Copyright © Atlas Copco

**Figure 12:** Atlas Copco Z-Series compressor and remote monitoring solution



**Figure 13:** The Sierra Wireless FX30 IoT Gateway can help to monitor the usage of compressors

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# Conclusions

Advances in cellular connectivity are helping to drive the development of the Industrial IoT, as mobile operators all over the world roll out Mobile IoT networks using LTE-M and NB-IoT. Within the next few years, GSMA Intelligence predicts IoT connections within smart manufacturing will grow at a rate of over 30% annually, increasing the number of devices to well over 600 million. In industry, demand is growing for the abilities these technologies can bring, including tracking valuable assets, relaying sensor data for environments and machines, collecting data for quality records, reducing costs and changing the available positions of deployment.

Many manufacturers, machine makers and logistics companies are now looking to harness the potential of these Mobile IoT technologies, which allow for:

- Dense deployment of many devices within one geographical area
- Longevity of devices and technology with support years into the future
- Reliability and security of cellular networks

- Extended coverage and deep penetration of wireless signals
- Flexibility as deployment moves from wired to wireless

Furthermore Figure 14 on the following page summarises the multiple benefits of using Mobile IoT over wired connections.

| SCALABILITY | |
| --- | --- |
| Cellular | Designed for dense endpoints |
| Wired | Difficult and costly to add large number of endpoints |
| **AFFORDABILITY** | |
| Cellular | No cabling costs<br>Zero-touch devices |
| Wired | Costly to install and maintain cabling<br>Cables can be damaged, extra cost to repair or replace |
| **FLEXIBILITY** | |
| Cellular | Connected assets can be re-deployed and moved easily<br>Easy to add connectivity to existing assets<br>Long lifespan: designed to co-exist with future generations |
| Wired | Difficult to re-deploy or move existing systems<br>Installation takes time and needs detailed planning |
| **MOBILITY** | |
| Cellular | Enables complete asset mobility<br>Connects both inside and outside facility |
| Wired | Bound to fixed locations<br>Limited asset placement |

**Figure 14:** Benefits of Mobile IoT over wired connections

Both the smart smoke detector from Hothink and the high precision screwdrivers used at the Ericsson Panda manufacturing plant in Nanjing highlight how Mobile IoT solutions can quickly realise deployment and maintenance cost savings. At the same time, the Atlas Copco industrial air compressors demonstrate how Mobile IoT connectivity can be used to monitor the usage of assets, even when they are installed in previously impenetrable locations.

The deployments outlined in this report show some of the many possibilities of using Mobile IoT technologies within industrial settings, giving insights into how multiple solutions could be combined within a single system in a production plant to build valuable data sets, increasing overall efficiency and cost savings. Mobile networks have the ability to expand this reach beyond the site if needed, enabling further improvements to logistics and manufacturing methods.

Moreover, Mobile IoT is firmly embedded into the 3GPP specification of 5G cellular technology, enabling deployment to start now and continue in the future with the addition of Critical IoT Communication technologies within one wireless cellular system.

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## ABBREVIATIONS

| TERM | DESCRIPTION |
| --- | --- |
| **3GPP** | 3rd Generation Partnership Project |
| **5G NR** | 5G New Radio |
| **Andon** | A signalling system used to notify for support in manufacturing |
| **CAN** | Controller Area Network |
| **Fixed line** | Telecommunications using cables laid across land |
| **HVAC** | Heating, ventilation and air conditioning |
| **IoT** | Internet of Things |
| **LPWA** | Low Power Wide Area |
| **LTE** | Long-Term Evolution |
| **LTE-M / LTE-MTC** | Long-Term Evolution Machine Type Communications |
| **mMTC** | Massive Machine Type Communications |
| **NB-IoT** | Narrowband IoT |
| **URLLC** | Ultra-reliable low latency communications |
| **VoLTE** | Voice over LTE |